Imperial Journal of Interdisciplinary Research (IJIR)
Vol-3, Issue-3, 2017
ISSN: 2454-1362, http://www.onlinejournal.in

Applications of Graph Theory in Everyday Life and Technology

Kiran Kaundal
Assistant Professor, Chandigarh Group of Colleges, Landran, Mohali.

Abstract— *This paper aims to emphasize the applications of graph theory in daily life and technologies (Computer science, Operation Research, Chemistry). This paper gives an overview of applications of graph theory in heterogeneous fields but focuses on Computer Science applications that uses graph theoretical concepts.*

Keywords- *Graph, Euler Graph, Hamiltonian Graph, Network, Operation Research.*

1. INTRODUCTION

Graph theory is a branch of discrete mathematics. Graph theory is the study of graphs which are mathematical structures used to model pair wise relations between objects. A graph is made up of vertices V (nodes) and edges E (lines) that connect them. A graph is an ordered pair G= (V, E) consisting a set of vertices V with a set of edges E.

Graph theory is originated with the problem of Koinsber bridge, in 1735. This problem escort to the concept of Eulerian Graph. Euler studied the problem of Koinsberg Bridge and established a structure to resolve the problem called Eulerian graph. In 1840, A.F Mobius presented the idea of complete graph and bipartite graph and Kuratowski proved that they are planar by means of recreational problems. The concept of tree, (a connected graph without cycles was enacted by Gustav Kirchhoff in 1845, and he enrolled graph theoretical ideas in the calculation of currents in electrical networks or circuits. In 1852, Thomas Gutherie established the famous four color problem. Then in 1856, Thomas. P. Kirkman and William R.Hamilton measured cycles on polyhydra and contrived the concept called Hamiltonian graph by studying trips that visited certain sites exactly once [3]. In 1913, H.Dudeney mentioned a puzzle problem. Eventhough the four color problem was invented it was solved only after a century by Kenneth Appel and Wolfgang Haken [10]. This is considered as origin of Graph Theory.

1.1. Eulerian Graph

Here we discuss the terms Euler Path and Euler Circuit, then define Eulerian Graph.

1.1.1. Euler Path: A simple path in a graph G is called Euler Path if it traverses every edge of graph exactly once.

Example: Fig.1 has Euler Path BDCABC as each edge appears exactly once.

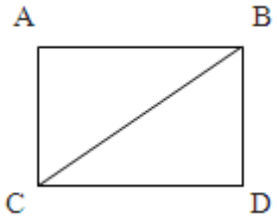

Fig. I

1.1.2. Euler circuit: Euler Circuit is a circuit in graph G which traverses every edge of graph exactly once. Euler Circuit is simply a closed path and called as Euler line.

Example: Fig.II has Euler Circuit ABCDA as each edge appears exactly once and it is closed.

Fig. II

1.1.3. Eulerian Graph: A graph which contains either Euler Path or Euler Circuit is called Eulerian Graph.

1.2. Hamiltonian Graph

First we discuss Hamiltonian Path and Hamiltonian Circuit.

1.2.1. Hamiltonian Path: A Hamiltonian Path in a connected graph is a path which contains each vertex of graph exactly once.

1.2.2. Hamiltonian Circuit: A Hamiltonian circuit is a circuit that contains each vertex of graph exactly once except for the first vertex, which is also the last.

1.2.3. Hamiltonian Graph: A graph which possesses either Hamiltonian circuit or Hamiltonian path is called a Hamiltonian graph.
Example: Fig.III has Hamiltonian circuit ABCDA as each vertex appears exactly once except A. So it is Hamiltonian Graph.

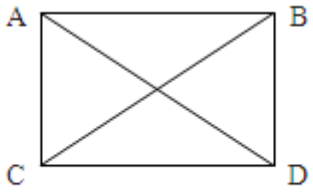

Fig.III

2. APPLICATIONS OF GRAPH THEORY IN EVERYDAY LIFE

There is n-number of applications of graph theory, few are represented as follows:

2.1. GPS or Google Maps

GPS or Google Maps are to find a shortest route from one destination to another. The destinations are Vertices and their connections are Edges consisting distance. The optimal route is determined by the software. Schools/ Colleges are also using this technique to pick up students from their stop to school. Each stop is a vertex and the route is an edge. A Hamiltonian path represents the efficiency of including every vertex in the route.

2.2. Traffic lights

The functioning of traffic lights i.e. turning Green/Red and timing between them. Here vertex coloring technique is utilized to solve conflicts of time and space by identifying the chromatic number for the number of cycles needed.

2.3. Social Networks

We connect with friends via social media or a video gets viral, here user is a Vertex and other connected users create an edge therefore videos get viral when reached to certain connections.

2.4. To clear road blockage

When roads of a city are blocked due to ice. Planning is needed to put salt on the roads. Then Euler paths or circuits are used to traverse the streets in the most efficient way.

2.5. While using Google to search for WebPages, Pages are linked to each other by hyperlinks. Each page is a vertex and the link between two pages is an edge.

2.6. The matching problem: In order to assign jobs to employees (servers) there is an analogue in software to maximize the efficiency.

3. APPLICATIONS OF GRAPH THEORY IN TECHNOLOGY

3.1 Graphs in Computer Science

3.1.1. Data Mining*:* Data mining is process of perceiving required information from huge data with the help of various methods. Mostly the data we deal with in data science can be shaped as graphs. These graphs can be mined utilizing known algorithms and various techniques in graph theory to understand them in better way, e.g. in social networks every person in the network could be supposed as a vertex and any connection between them is supposed as an edge. Any problem related to logistics could be modelled as a network. Graph is captivating model of data backed with a strong theory and a set of quality algorithms to solve related problems.

3.1.2. GSM Mobile Phone Networks and Map Coloring*:* All mobile phones connect to the GSM network by searching for cells in the neighbors. Since GSM operate only in four distinct frequency ranges, it is clear by the concept of graph theory that only four colors may be utilized to color the cellular regions. These four different colors are used for proper coloring of the regions. The vertex coloring algorithm can be used to allocate at most four distinct frequencies for any GSM mobile phone network.

3.1.3. Web Designing

Website designing can be modeled as a graph, where the web pages are entitled by vertices and the hyper links between them are entitled by edges in the graph. This concept is called as web graph. Which investigate the interesting information? Other implementation areas of graphs are in web community. Where the vertices represent classes of objects, and each vertex representing one type of objects, and each vertex is connected to every vertex representing other kind of objects. In graph theory such a graph is called a complete bipartite graph. There are many benefits graph theory in website development like: Searching and community discovery, Directed Graph is used in web site utility evaluation and link structure. Also searching all connected component and providing easy detection.

3.2. Graphs in OR

Graph theory is dynamic tool in combinatorial operations research. Some important Operation Research problems which can be explained using graphs are given here. Transport network is used to model the transportation of commodity from one destination to another destination. The objective is to maximize the flow or minimize the cost within the suggested flow. The graph theory is established

as more competent for these types of problems though they have more constraints.

3.3. Graphs in Chemistry

The structural formulae of covalently bonded compounds are graphs; they are known as constitutional graphs. Graph theory provides the basis for definition, enumeration, systematization, codification, nomenclature, correlation, and computer programming [7]. The chemical information is associated with structural formulae and that structural formulae may be systematically and uniquely indexed and redeemed. One does translate chemical structures into words by nomenclature rules. The importance of graph theory for chemistry originates mainly from the existence of the phenomenon of isomerism, which is extenuated by chemical structure theory. This theory accounts for all constitutional isomers by using purely graph-theoretical methods.

4. CONCLUSION

The objective of this paper is to investigate applications of graph theory in technology. This paper is valuable for students and researchers to get the overview of graph theory and its application in diverse fields like everyday life, computer science, Operation Research, Chemistry. There are many problems in this area which are yet to be examined. This review would magnetize many new researchers into graph theory.

5. REFERENCES

[1] A, Prathik; K, Uma; J, Anuradha, (2016);"*An Overview of application of Graph theory*",http://sphinxsai.com/2016/ch_vol9_no2/1/(242-248)V9N2CT.pdf.

[2] Balaban, A. T., Ed. Chemical (1967),"*Applications of Graph Theory*"; Academic Press: London.

[3] Besjana; Tosuni; Albania; "*Some interesting topics of Graph Theory in Modern Computer Science and Engineering*" ISSN 1946-4690

[4] Daniel Marx, "*Graph Coloring problems and their applications in scheduling*".

[5] Eulerian and Hamiltonian Graphs http://compalg.inf.elte.hu/~tony/Oktatas/TDK/FINAL/Chap%203.PDF.

[6] Fayyad; U. Shapiro; G.P. and Smyth, P; "*From data mining to knowledge discovery in Databases*," AI Magazine, 1996, 37-53.

[7] Narasingh; Deo; "*Graph theory with applications to engineering and computer science*", Prentice Hall of India, 1990.

[8] Nishizeki, Takao; Tamassia, Roberto; Wagner, Dorothea. -Berlin: Springer, "*Graph algorithms and applications: special issue*" 2000 - (Algorithmica:26.2000, 1).

[9] S.RishiPal; Vandana;(2014) "*Application of graph theory in Computer Science and Engineering*", http://research.ijcaonline.org/volume104/number1/pxc3899025.pdf

[10] S.G.Shirinivas, S.Vetrivel and Dr. N.M.Elango,(2010), "*Applications of graph theory in computer science an overview* " http://www.cs.xu.edu/csci390/12s/IJEST10-02-09-124.pdf

[11] S. Pirzada and Ashay Dharwardker, " *Application of Graph Theory*" J.KSIAM VOL.11,No.4, 19-38, 2007.

[12] Shamim Ahmed, "*Applications of Graph Coloring in Modern Computer science*" (ijcit, issn 2078-5828 (print), issn2218-5224 (online), volume 03, issue 02, manuscript code: 130101(2012)

[13] Shariefuddin; Pirzada; Ashay Dharwadker "*APPLICATIONS OF GRAPH THEORY*",http://www.dharwadker.org/pirzada/applications/.

[14] Suman Deswal and Anita Singhrova, "*Application of graph theory in communication networks*" International Journal of Application or Innovation in Engineering & Management (IJAIEM), Volume 1, Issue 2, and October 2012.

[15] Tami (College Station ISD); Sarah Kostroun (Midway ISD); Dr. Dylan A. Shell, "*Graph Theory in everyday life*".